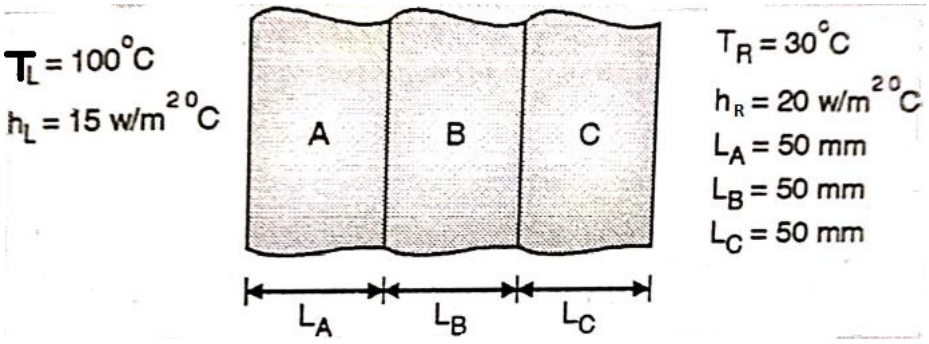
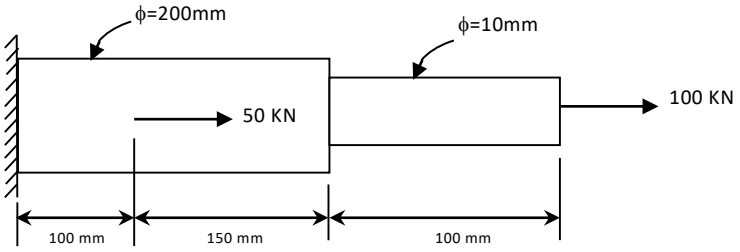
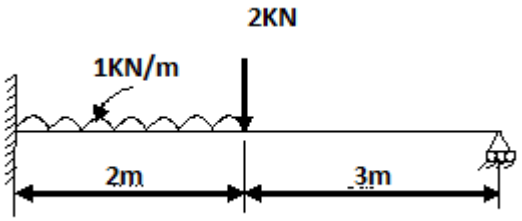
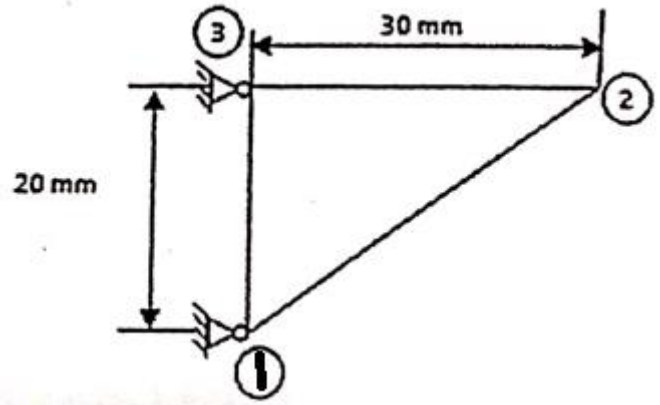
SVKM's
D. J. Sanghvi College of Engineering

Program: B.Tech in Mechanical Engineering **Academic Year: 2022** **Duration: 3 hours**
Date: 13.01.2023
Time: 10:30 am to 01:30 pm
Subject: Finite Element Analysis (Semester VII) **Marks: 75**

Question No.		Max. Marks
Q1(a)	Solve the following differential equation using Galerkin and Subdomain Method and compare the result at x=0.5 using exact method. $\frac{d^2\Phi}{dx^2} + \Phi - x^2 = 0$; $0 \le \phi \le 1$; $\phi(0) = 0$, $(d\phi/dx)\,(1) = 1$ **OR** The governing differential equation for the steady state one dimensional conduction heat transfer with internal heat generation is given by $\frac{d}{dx}\left[k\frac{dT}{dx}\right] = q$ for $0 \le x \le L$ were k= coefficient of thermal conductivity of the material, q= internal heat generation Develop the finite element formulation for linear element. Use Rayleigh Ritz method, mapped over general element.	[10]
Q1(b)	Compare Classical, Numerical and experimental methods.	[05]
Q2 (a)	Explain in detail the steps involved in the Finite Element analysis of plane truss. **OR** Find the heat transfer per unit area through the wall and temperature at interface for the fig. shown. $K_A = K_B = K_c = 40$ W/m°C 	[10]

Q2 (b)	State and explain Principle of minimum total potential Energy	[05]
Q3 (a)	Find the displacement, stresses and strain in the elements of stepped bar as shown in figure. Take E = 200GPa.  **OR** Find the deflection and slopes at nodes and reactions at supports for the beam as shown in figure. Take EI = 400 KN-m^2.  	[10]
Q3 (b)	Explain h-type and p-type elements.	[05]
Q4 (a)	Derive the quadratic shape functions of Lagrange's family for 1D element. Plot the shape function along the length of the element. What are the characteristics of the shape function? **OR** Derive shape functions for 8 noded rectangular elements.	[06]
Q4 (b)	Find the natural frequency of axial vibrations of a bar of uniform cross section of 1 m^2, length 1m with left end fixed. Take E = 2 x 10^5 MPa and ρ = 7800 kg/m^3. Take one linear elements. Use both the Consistant and lumped mass matrix and compare the results with exact solution.	[09]
Q5 (a)	Derive the shape functions for CST element. The triangular element has nodal coordinates (1, 2), (4,0.5) and (3,4) for nodes 1, 2 and 3 respectively. The co-ordinate of the point P located inside the triangle is (2.5, 2.5), The nodal values of field variables at the nodes are (3.5, 2.2, 4.4) respectively. Find the value of variable at P. **OR** A triangular element (E=210GPa, μ=0.3) of thickness 10mm is shown in Fig. Node 1 and 3 are fixed and the displacement of node 2 are 0.000195mm and -0.001114mm in x and y direction respectively. Determine the element stresses assuming plane stress condition	[10]

		
Q5 (b)	Explain the sources of errors in FEA	05